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TROUT IN LOUGH REA, CO. GALWAY

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Communicated by Arthur E. J. Went.

Lough Rea, as mentioned in a previous publication (Went, 1949), is about one and three quarter miles long and a mile at its widest part. Its area is 725 acres. It is highly alkaline (*p* H 8·4). It has two small streams flowing into it and two small streams flowing out. The shores are for the most part rocky, except for a few sandy bays with reed beds on the south-eastern and in a small area on the south-western shores. Extensive areas of the bottom are covered with large limestone boulders, whilst around the crannogs (stockaded islands), it is marly with a thick growth of calcified *Chara*. The depth varies considerably but it is generally shallow (less than 6 to 8 feet), although in one place it reaches 120 feet in the centre of the lake.

In the early twenties a few small slow-growing trout from Lough Atorick, a nearby acid lake, were introduced into the lake which had previously been stocked only with coarse fish. Further stocks of trout were introduced from Lough Atorick in 1936 and in 1939. These stocks were supplemented by fry hatched out locally from ova supplied from the highly alkaline Lough Owel in the County Westmeath. The local hatchery has been operating annually since 1939.

This paper is based on material consisting of brown trout scales, together with relevant data (length, weight, and date of capture) and stomach contents of a small proportion of the fish. The material was kindly collected for me by the Loughrea Anglers' Association in the years 1949 to 1952 inclusive. The results obtained by

Went from material collected in 1948 are given in this paper for the sake of comparison. The scales were first cleaned in a dilute solution of sodium peroxide and mounted on slides with gelatine.

Age.—The age of each fish was determined by examination of the scales. The numbers examined in the different age groups are given in Table I (see Appendix for all tables). The paucity of fish in the higher age groups is probably due to their not rising to the fly, and the almost complete absence of 1-year-olds is accounted for by the 9-inch limit which is imposed by the Association. The four fish which were less than 9 inches were found dead in one of the streams in 1952.

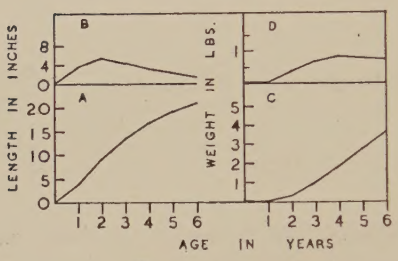

FIG. 1.

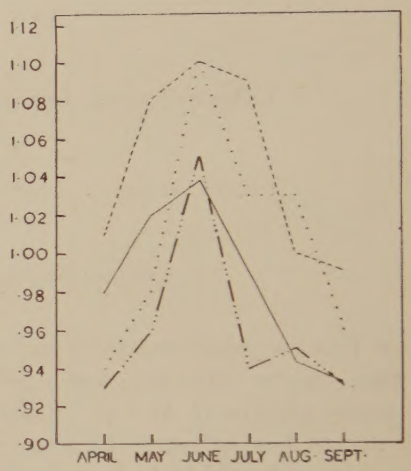

FIG. 2.

FIG. 1. Average growth of trout in Lough Rea 1948-1952 inclusive.
A.—Average length in inches.
B.—Average length increments.
C.—Average weight in pounds.
D.—Average weight increments.

FIG. 2. Average monthly condition co-efficients for the 2-group and all fish in 1949 and 1952 in Lough Rea.

Broken line	2-group	1949
Full line	all fish	1949
Dotted line	2-group	1952
Dots and dashes	all fish	1952

Growth.—The growth rate of the fish was calculated in the usual way, i.e., on the assumption that the growth of the fish was strictly proportional to the growth of the scales. The mean growth rates are given in Table 2. The results for the five years combined are illustrated graphically in Fig. 1A.

The growth rates of the various age groups were very similar in the different years under review (Table 2) and all trout grew rapidly in their second year, the average increases in lengths being 5.9 inches in 1948, 6.1 inches in 1949, 5.7 inches in 1950, 6.2 inches in 1951 and 6.5 inches in 1952. As will be seen in Fig. 1B the average increment in growth was greatest in the first three years of life. The increments shown underlined should be disregarded because of the small numbers of fish involved.

Condition Co-efficient.—The Condition Co-efficient (K) or the length/weight relationship was determined according to the formula $K = 10^6W/427L^3$ where L = length in inches and W = weight in pounds (Nall, 1931). The average value of K was: 1948, 0.93; 1949, 1.01; 1950, 0.92; 1951, 0.91 and 1952, 0.98, respectively.

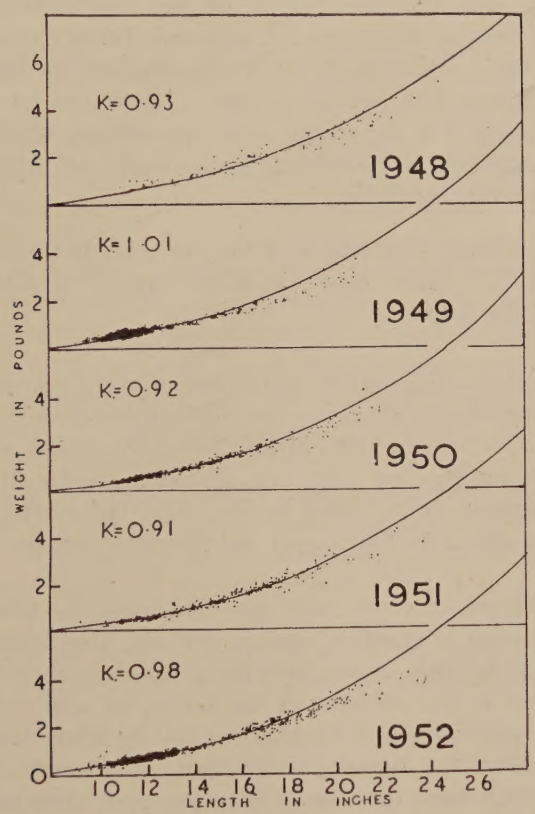

FIG. 3. Length/weight relationship in Lough Rea trout 1948-1952 inclusive (4 fish less than 9 ins. in 1952 not represented).

An alternative method of expressing the length/weight relationship is given by Corbetts formula, i.e. C.F. (Condition Factor) $= 10^6 W / L^3$ where W = weight in pounds and L = length in inches as in the previous formula. The relationship between the two factors is obviously C.F. = K x 42.7.

The average monthly values of the condition co-efficient were not calculated for the years 1948, 1950 and 1951, but in Fig. 2 the average monthly values for all fish and for the 2-group (fish in their third year) examined in 1949 and 1952 have been given. The mean Condition Co-efficient shows a maximum value in June, and a steady decline thereafter. This decline may be accounted for by the fact that fish cease active feeding to some extent about this time. The 2-group reached an average value of 1.1 in June in both 1949 and 1952.

The length/weight relationship for all the fish has been shown in Fig. 3. The curve in each case represents the average value of K for the years in question. In Fig. 3 it will be seen that the smaller fish had Condition Co-efficients above the average, whilst most of the larger fish were well below average in 1948, 1949, 1950 and 1952. (This is contrary to the results obtained by Southern for Lough Derg trout, where K rose with increase in age). The reason for this may be that, in the case of the larger fish, the gonads were approaching ripeness, and, as they were not feeding actively, the condition deteriorated. In 1951 the middle age groups were above average condition.

The average Condition Co-efficients of the two sexes in the various age groups are given in Table 3. There is not, it would appear, a substantial difference between the sexes in this respect.

Calculated Weights.—The weights at the end of every year of life were calculated using Nall's formula (see above) on the basis of the average value of K for all trout of all ages for each of the years in question. The results are given in Table 4, and the averages for the five years are illustrated graphically in Fig. 1C, the average annual increments being shown in Fig. 1D. The annual weight increment rises rapidly until the end of the fourth year and thereafter declines.

Sex Ratio.—The sex of 1,337 trout was determined by internal examination over the five year period in question, and 49 per cent were females (see Table 5). Hence there seems to be little or no disparity in numbers between the two sexes. This was also evident in two stretches of the Liffey, an acid and an alkaline one (Went and Frost, 1942), whereas in Lough Derg and the River Shannon at Meelick, which are both alkaline, the disparity was roughly two females to one male. In Lough Atorick, which is acid, the females were also more abundant than the males (Southern, 1935). Similarly females were more numerous than males in Lough Rea in 1950 and 1952. In 1948 the percentages were reversed. In 1949 they were virtually equal and in 1951 there were 22 per cent more males than females.

Food.—The stomach contents of nine trout taken in 1950, two trout taken in 1951, and sixteen trout taken in 1952, were examined and the nature of the food was found to be as follows:—

Insecta (winged)	dominant in	1	present in	8
Trichoptera (larvae)	,,	,, 4	,,	,, 10
Chironomidae (larvae)	,,	,, 0	,,	,, 3
Ephemeridae (nymphs)	,,	,, 1	,,	,, 3
Odonata (nymphs)	,,	,, 3	,,	,, 7
Chironomidae (pupae)	,,	,, 4	,,	,, 11
Coleoptera (adults)	,,	,, 0	,,	,, 3
Gammarus	,,	,, 3	,,	,, 6
Asellus	,,	,, 8	,,	,, 10
Corixa	,,	,, 2	,,	,, 2
Mollusca	,,	,, 1	,,	,, 3

The most important food consisted of insect larvae, of which those of *Trichoptera* (Caddis Flies) were frequently present. At Meelick on the Shannon, according to Southern (1935), insect larvae also made up the bulk of the food. In that station, however, those of *Simulium* predominated; caddis larvae were of some importance, and Mayfly nymphs (*Ephermeridae*) were most frequently present, but were only dominant in six out of twenty-one fish examined. Mayfly nymphs were present in three fish in Lough Rea and were dominant in one. In Lough Derg in May and early June the food consisted mainly of Mayfly nymphs, whilst in Lough Rea the nymphs were dominant in one fish only. Adult *Ephemera danica* were present in one other fish (of nine fish examined). Of the other *Chironomid* pupae predominated in three, *Asellus* in three and Caddis larvae in one. *Chironomid* pupae and *Asellus* were eaten frequently in Lough Rea in large numbers. Nymphs of a species of Damsel fly (*Odonata*) were present in seven fish, and were dominant in three. Specimens of *Gammarus* were present in six fish, and were dominant in three. *Corixa* was present in two fish, in which it was dominant. Though Molluscs are very prevalent in Lough Rea they were only present in three fish, and were dominant in one. Adult insects found were nearly all of terrestrial origin having presumably been blown on to the water from the land.

Parasites.—Parasitic worms of the species *Echinorhynchus salmonis* (Müller, 1774) were found in the stomachs of some trout, the details being as follows:—

Date of capture.	Length of fish.	Number of parasites.
June, 1951	15″	16
April, 1952	16″	200
May, 1952	12″	10
June, 1952	12″	1
June, 1952	12″	1

Tapeworms of the species *Eubothrium crassum* (Bloch, 1779) nine in number, were found in a trout 21 inches long taken in June, 1952. These parasites were kindly identified for me by Mr. S. Prudhoe, British Museum (Natural History), London.

Discussion.

It is interesting to note that the high growth rate reported by Went in 1949 has been kept up over the whole of the period under review, and therefore there seems to be no doubt that growth rates of this order can be maintained in this lake in future. As some of the present trout in Lough Rea are the descendants of small slow-growing trout from Lough Atorick, investigated by Southern (1935), it is obvious that the growth rate is in the main independent of the origin of the fish concerned. Environmental factors would, therefore, appear to be the most important in determining the relative growth rates.

The Loughrea Anglers' Association is continuing its efforts in conjunction with the Fisheries Branch of the Department of Agriculture to reduce the stocks of perch, pike, and rudd, in this lake, as well as to augment the stocks of brown trout with fry hatched out locally from ova supplied from outside sources. In addition about four hundred female trout from the lake were stripped from 1950 to 1952 inclusive, yielding approximately 250,000 ova. Planting of small fish from Lough Atorick and elsewhere is also being continued. It is unnecessary at this stage to do more than refer to the removal of the so-called coarse fish as this will, in due course, be the subject of another paper.

Summary.

1. Material consisting of sets of scales and data collected from brown trout caught on rod and line by members of the Loughrea Anglers' Association from 1948 to 1952 was examined.

2. The majority of fish in 1948, 1950, and 1951, belonged to the 3-group, whereas in 1949 and 1952 the fish in the 2-group far out-numbered the total of the other age groups (Table 1).

3. The increment in growth which was calculated from scale measurements decreased after the first three years of life and the greatest increment was made in the second year. (Table 2 and Fig. 1).

4. There was generally a gradual rise in the average Condition Co-efficient from May to June, and a steady decline thereafter (Fig. 2). The mean Condition Co-efficients for the five years in question ranged from 0.91 to 1.01 (Fig. 3).

5. The weight increments generally increased up to the end of the fourth year and decreased thereafter. (Table 4 and Fig. 1).

6. The proportion of females varied from 36 per cent in 1948 to 64 per cent in 1950.

7. The food of the trout examined consisted mainly of insect larvae, *Chironomid* pupae and *Asellus*.

ACKNOWLEDGMENTS.

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TABLE 1. Number of fish examined in the different age groups in the years 1948 to 1952 inclusive.

Year	No. Examined x	AGE GROUP (IN YEARS)						
		1	2	3	4	5	6	7
1948	138	-	19	65	28	19	6	1
1949	464	-	327	85	48	4	-	-
1950	262	-	86	109	40	24	3	-
1951	195	1	56	73	52	12	1	-
1952	421	5	238	72	55	40	11	-

xLengths of all fish not available.

TABLE 2. Calculated growth rates in the different years.

Year	Number Examined					LENGTH IN INCHES														Average annual increment				
						Minimum					Average					Maximum									
	1948	1949	1950	1951	1952	1948	1949	1950	1951	1952	1948	1949	1950	1951	1952	1948	1949	1950	1951	1952	1948	1949	1950	1951	1952
1	135	464	261	195	421	1.8	1.7	1.6	1.9	1.8	3.5	3.4	3.7	4.3	3.4	6.5	5.8	6.3	6.9	6.4	3.5	3.4	3.7	4.3	3.4
2	135	464	261	194	416	4.0	5.1	5.0	6.1	6.1	9.4	9.5	9.4	10.5	9.9	14.0	17.7	13.6	13.4	14.7	5.9	6.1	5.7	6.2	6.5
3	116	137	175	137	178	8.2	9.4	7.3	9.3	9.5	13.8	14.2	13.2	13.8	13.7	19.4	22.3	17.9	17.6	18.3	4.4	4.7	3.8	3.3	3.8
4	52	51	66	64	106	11.3	12.1	9.4	13.6	11.4	17.2	17.1	16.4	16.8	16.7	22.2	24.5	21.6	21.3	21.3	3.4	2.9	3.2	3.0	3.0
5	28	4	27	12	51	14.6	16.3	11.8	17.0	14.7	19.3	19.7	18.5	19.4	18.6	23.3	25.1	23.8	22.6	22.4	2.1	2.6	2.1	2.6	1.9
6	7	-	3	1	11	18.8	-	19.3	-	17.2	20.7	-	20.5	22.0	20.1	23.5	-	21.0	-	23.4	1.4	-	2.0	2.6	1.5
7	1	-	-	-	-	-	-	-	-	-	24.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figures underlined based on small numbers.

TABLE 3. Mean Condition Co-efficients in the different age groups in the different years of the two sexes.

Year	AGE GROUP (IN YEARS)											
	1		2		3		4		5		6	
	M	F	M	F	M	F	M	F	M	F	M	F
1948	-	-	1.1	0.98	0.97	0.98	0.89	0.97	0.85	0.84	0.87	0.73
1949	-	-	1.04	1.06	0.93	0.94	0.87	0.85	0.82	0.70	-	-
1950	-	-	0.95	0.93	0.92	0.93	0.87	0.91	0.93	0.87	-	-
1951	-	1.16	0.86	0.88	0.92	0.94	0.89	0.92	0.85	0.82	-	-
1952	0.79	0.81	1.00	0.99	0.97	0.98	0.93	0.97	0.86	0.94	0.85	0.79

TABLE 4. Calculated weights for each age group in the different years.

Year	WEIGHT IN LBS.					WEIGHT INCREMENTS IN LBS.				
	1948	1949	1950	1951	1952	1948	1949	1950	1951	1952
1	0.017	0.017	0.02	0.03	0.016	0.017	0.017	0.02	0.03	0.016
2	0.36	0.37	0.34	0.45	0.42	0.34	0.35	0.32	0.42	0.59
3	1.09	1.23	0.90	1.02	1.09	0.73	0.86	0.56	0.57	0.67
4	2.0	2.15	1.77	1.84	1.97	0.91	0.92	0.87	0.82	0.88
5	2.86	3.39	2.48	2.83	2.65	0.86	1.14	0.71	0.99	0.68
6	3.47	-	3.38	4.14	3.35	0.61	-	0.90	1.31	0.70

Figures underlined are based on small numbers.

TABLE 5. Proportion of the sexes in each age group for the different years (as percentages).

Year	Number Examined	AGE GROUP (IN YEARS)														%	%
		1		2		3		4		5		6		7			
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1948	118	-	-	68	32	60	40	54	46	80	20	67	33	100	-	64	36
1949	417	-	-	43	57	70	30	74	26	50	50	-	-	-	-	52	48
1950	232	-	-	28	72	35	65	50	50	52	48	-	100	-	-	36	64
1951	164	-	-	6	94	28	72	55	45	45	55	100	-	-	-	61	39
1952	406	75	25	31	69	39	61	54	46	67	33	50	50	-	-	40	60